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IS 12398 (1988): Multipurpose Mercury Barometer (for Educational Use) [PGD 22: Educational Instruments and Equipment]

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IS : 12398 - 1988

Indian Standard

(Reaffirmed 2001)

SPECIFICATION FOR MULTIPURPOSE MERCURY BAROMETER (FOR EDUCATIONAL USE)

Educational Instruments and Equipment Sectional Committee, EDC 77; Physical Science Subcommittee, EDC 77 : 1 [Ref : Doc : EDC 77 (4684)]

1. **Scope** — Covers the design and general requirements of a multipurpose mercury barometer for use in educational institutions. One can easily produce vacuum above the mercury surface without the aid of any other instrument/equipment. The instrument may also be used as a manometer and for the study of Boyle's law from 0·7 to 1·3 atmosphere.

2. **Description** — The basic principle of the mercury barometer is that the pressure of the atmosphere is balanced against the weight of a column of mercury, the height of the column being taken as a measure of the pressure. The essential design of this barometer is similar to a manometer in one arm of which there is provision to make vacuum above the surface of mercury (*see* Fig. 1). This is done by first expelling all the air by raising the mercury level a little above the capillary neck of that arm. The neck is then closed vacuum tight with the help of a needle made of a soft material. A little of mercury trapped around the needle in the mercury seal, closes the minute pores between the surface of the needle and glass surface of the neck of the barometer tube. This arm is then raised and the other arm lowered till mercury in the closed are starts moving down, thus making a vacuum above its surface.

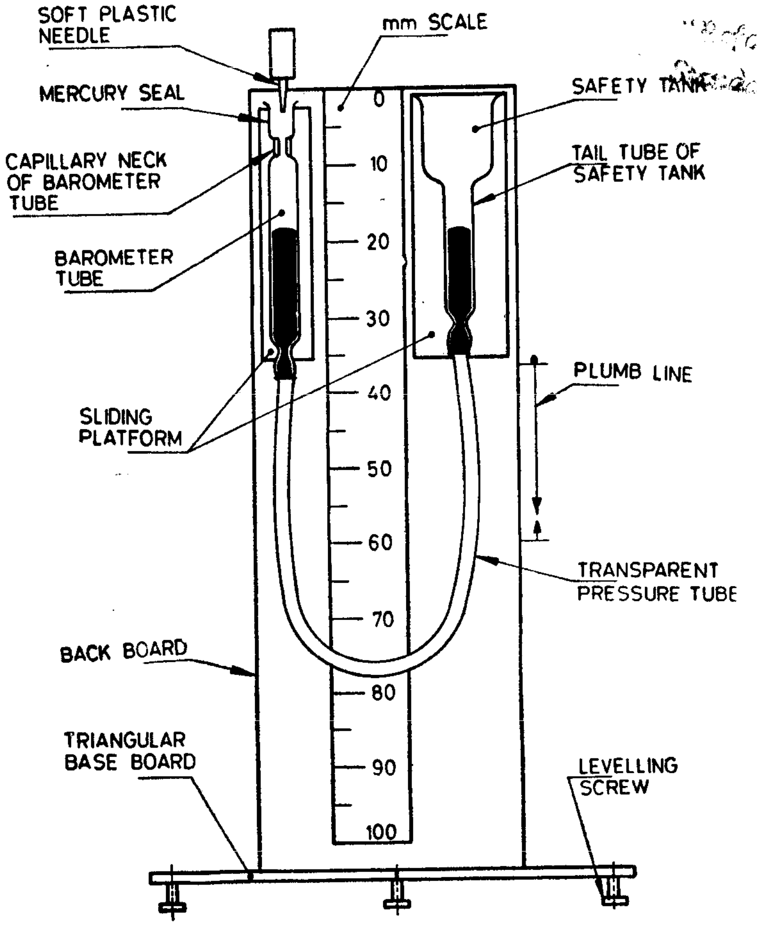

FIG. 1 MULTIPURPOSE MERCURY BAROMETER

Adopted 10 May 1988	© October 1988, BIS	Gr 3

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Thereafter, position of mercury levels in the two arms are read on a scale graduated in millimetres. Since the scale must be vertical in order to give correct height of the mercury column in the closed arm which balances the atmospheric pressure a plumb line and levelling screws in the base are necessary adjuncts to the instrument.

To read the levels of mercury on the scale, two tools of such design are used which hold on to the scale, one for each arm. An arm of each tool projects behind the mercury column. The upper edge on this arm and a mark on the cursor whose position can be read on the scale, make a line precisely perpendicular to the scale. A milk white reflector behind the mercury column enables position of the cursor to be so adjusted that upper edge of its arm behind mercury coincides with the upper miniscus of mercury (*see* Fig. 2). The cursor is made symmetrical above and below its central line so that a person, if he so likes, can use its lower edge to read the position of mercury level on the scale. The milk white reflector behind barometer tube also has a scale on it for measuring length of the column of vacuum (or of air) in this tube above the surface of mercury.

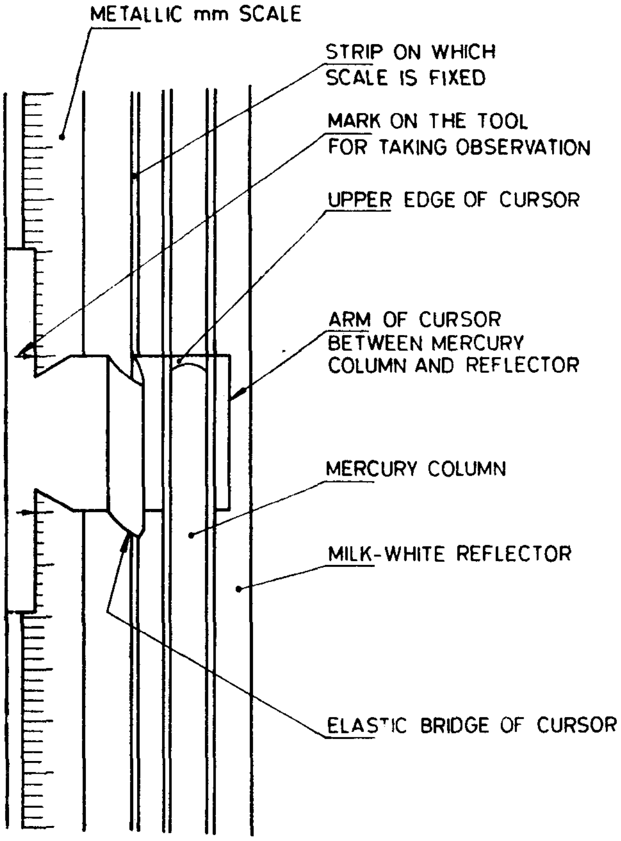
METALLIC mm SCALE
STRIP ON WHICH SCALE IS FIXED
MARK ON THE TOOL FOR TAKING OBSERVATION
UPPER EDGE OF CURSOR
ARM OF CURSOR BETWEEN MERCURY COLUMN AND REFLECTOR
MERCURY COLUMN
MILK-WHITE REFLECTOR
ELASTIC BRIDGE OF CURSOR

FIG. 2 CURSOR FOR OBSERVING POSITION OF MERCURY LEVEL ON SCALE

3. Material

3.1 The glass tube in both arms shall conform to IS : 7374-1974 'Specification for glass rods and tubings for laboratory glassware' and thoroughly annealed so as to withstand the atmospheric pressure. The glass shall be perfectly clear, dry and free from grease.

3.2 The mercury used in the barometer shall be of a high order of purity and give a definitely convex surface to the miniscus in the glass tube, both while moving up and while moving down.

3.3 The tube connecting the two arms shall be of clear plastic of good quality in order to be able to see that no air bubble is trapped on its inner surface. Its wall thickness shall be sufficient to withstand the atmospheric pressure.

3.4 The vertical scale shall be printed or etched on a strong metallic strip and attached to the back board in such a manner that, if the board swells during rainy season, the scale is not destorted or effected in any way.

3.5 The reflector behind the barometer tube and that behind the tail tube of safety tank shall be milk white.

3.6 The sliding platform on which the barometer tube and safety tank are fitted shall be of metal or of seasoned wood so that they do not get deformed in humid season and their vertical motion remains smooth.

3.7 Each cursor for reading mercury level shall be made of elastic material and include an elastic bridge in its design, so that it has a good grip on the strip on which the scale is fixed and at the same time it can smoothly slide along the scale in spite of some swelling or contraction of the strip in different seasons.

3.8 The needle shall be made from suitable soft wear resistant material. It shall be of conical shape with semi-vertical angle of not more than 2° and shall be mounted on a handle for easy handling (*see* Fig. 3).

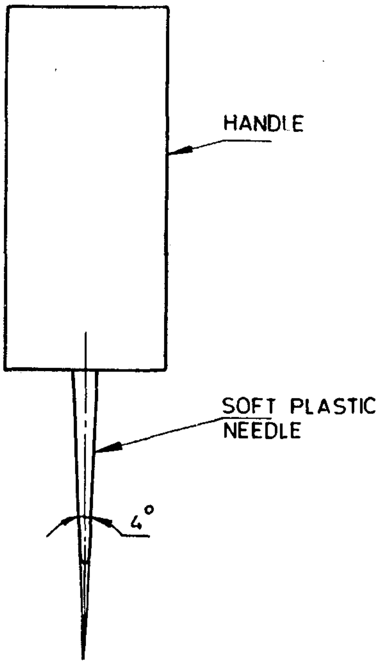

FIG. 3 SOFT PLASTIC NEEDLE

4. Dimensions — The equipment shall have main dimensions as given below (*see* Fig. 1 and 2):

Internal diameter of barometer tube : 8 to 10 mm
Internal diameter of tail tube of safety tank : Equal to that of internal diameter in the same instrument
Range of vertical movement of barometer tube : 30 cm, *Min*
Range of vertical movement of safety tank : 70 cm, *Min*
Length of barometer tube : 20 cm, *Min*
Length of tail tube of safety tank : 15 cm, *Min*
Internal diameter of transparent pressure tube : 2 to 3 mm
Internal diameter of neck of barometer tube : 1·5 mm, *Max*
Length of scale : 85 to 95 cm
Side of equilateral triangular base : 25 cm, *Min*
Length of plumb line : 15 cm, *Min*
Capacity of safety tank along with tail tube : At least so much that with its lowest position and barometer tube in the highest position, and kept open when entire mercury comes in the safety tank, mercury remains at least 2 cm below the mouth of the safety tank.

Width of the marks on the cursor for reading the position of mercury level : 0·2 mm, *Max*

Depth of mercury seal above the neck of the barometer tube : 15 to 25 mm

5. General Requirements

5.1 A cap shall be provided on the safety tank and on the barometer tube so as to prevent dust entering them.

5.2 The boards on which the safety tank and the barometer tube are fitted shall be free to move along the scale and the motion shall not get blocked or become hard at any point in its range. They shall be provided with mechanisms to fix with them at any position along their range of motion.

5.3 The two cursors to read the position of two mercury levels on the scale shall be so shaped that, while observing a mercury level, the observer can find out whether his eyes are at the same horizontal level as the upper edge of the cursor.

6. Tests and Accuracy

6.1 With the scale adjusted vertical and the barometer tube open to atmosphere, mercury will stand at the same level in both the arms of the instrument. However, their positions as read on the scale by their respective tools shall not differ by more than 2 mm.

6.2 Due to some absorbed gases on the inside surface of the barometer tube and on the surface of soft plastic needle, the vacuum above the surface of mercury is never perfect. The pressure of these gases, when a vacuum space of 10 cm is produced, shall not exceed 1 mm of mercury, in a cold dry weather and shall not exceed 10 mm of mercury in a warm wet weather.

6.3 When the pressure inside the transparent pressure tube is less than atmospheric pressure, the adsorbed gases on its inside surface soon appear and make microscopic bubbles. Thus the shining mercury surface inside the tube becomes foggy in appearance. The tube shall be of such quality that this does not happen for at least 5 minutes (the time required for taking a reading) after the safety tank is lowered to make vacuum above the mercury surface in the barometer tube. If after so making the vacuum, the instrument is kept as it is with mercury surface foggy due to minute air bubbles, then for 4 hours no bubble of adsorbed gases shall become so large that it leaves the plastic surface and moves up to spoil the vacuum.

6.4 With mercury filled in it, the miniscus of mercury shall be convex both while moving up and while moving down.

6.5 The accuracy of the metallic scale shall be ±0·2 between the smallest divisions and in no case the accumulated error between the divisions shall exceed ±0·3 mm, when compared with a standard metre scale.

6.6 The surface of the soft plastic needle shall be so smooth that if some air at atmospheric pressure is kept in the barometer tube with no mercury trapped around the needle, in the mercury seal and a pressure difference of 10 cm of mercury is applied, then due to leakage of air through it, mercury level shall not move by more than 1 mm in one hour

7. Workmanship and Finish

7.1 The barometer scale shall be printed, etched or engraved with fine black lines of uniform thickness and depth throughout and lacquared with colourless lacquer.

7.2 The back board and base shall be finished smooth and polished/painted.

8. Marking

8.1 All multipurpose mercury barometers shall have a plate fixed on the base with the following inscription engraved on it:

a) The name of the manufacturer or trade-mark;
b) Standard conditions (temperature is 0°C, $g = 980{\cdot}665\ \text{cm/s}^2$); and
c) Serial number of the unit.

8.2 *Standard Mark* — Details available with the Bureau of Indian Standards.

9. Packing

9.1 The glass components of the multipurpose barometer shall be packed for transport in a special box of thermocole or other suitable soft material. The ends of the safety tank, pressure tube and the barometer tube shall be plugged. The sliding platforms the base board and the back board with scale attached on it shall be packed in separate box.

10. Testing and Inspection

10.1 Each multipurpose barometer shall be tested individually for conformity to the requirements of this specification.

EXPLANATORY NOTE

This standard is one of a series of Indian Standards relating to educational instrument/equipment.

In the preparation of this standard, due consideration has been given to the requirements prescribed by the National Council of Educational Research and Training, New Delhi.

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